

REMARKS

Applicants have incorporated into claims 1 and 11 the limitation “using a distillation column without a filler” recited in claim 5. The amendment to claim 1 has necessitated the cancellation of claim 5 and the change of dependency of claim 6. Applicants have also amended claims 3, 7, 11, 14, 15, 16, and 19 to promote clarity or correct minor deficiencies. No new matter has been introduced by the above amendments.

Upon entry of the proposed amendments, claims 1-4 and 6-19 will be pending and under examination. Reconsideration of the application, as amended, is respectfully requested in view of the remarks below.

Claim objection

Claim 11 is objected to as being containing a typographical error. Specifically, the Examiner points out that “[t]he word ‘fraction’ in the term ‘fraction distillation’ should be ... replaced with the word ‘fractional’.” See the Office Action, page 2, lines 3-5. Applicants have made the correction.

Rejection under 35 U.S.C. § 112, 2<sup>nd</sup> paragraph

Claims 1-19 are rejected as being indefinite on six grounds. See the Office Action, page 2, line 10 to page 4, line 7. Applicants traverse each ground as follows:

(1) The Examiner points out that “[i]t is unclear that a trialkanolamine is obtained after the redistillation step (the last line of ... claim [1])” and suggests that “to avoid any possible ambiguity, ... the clause ‘to obtain a trialkanolamine’ should be inserted as the last clause in the claim.” See the Office Action, page 2, lines 12-15. Applicants have added the phrase “to obtain the trialkanolamine” to claim 1.

The Examiner asserts that “[i]t is also unclear if ammonia, water, a monoalkanolamine and a dialkanolamine are indeed the ‘low-boiling substances’ removed ‘... to obtain a mixture deprived of [these] low-boiling substances.’” See the Office Action, page 2, lines 15-17. Applicants disagree. Claim 1 covers a method of producing a trialkanolamine. The smallest trialkanolamine is trimethanolamine, which has the lowest boiling point among all

trialkanolamines. However, the boiling point of trimethanolaminem, i.e., 284°C, is still much higher than those of ammonia (-33°C), water (100°C), monomethanolamine (114°C), and dimethanolamine (206°C) recited in claim 1. Thus, contrary to the Examiner's assertion, it is clear that ammonia, water, a monoalkanolamine and a dialkanolamine are indeed the low-boiling substances removed from the reaction mixture generated from the first step recited in claim 1.

(2) The Examiner indicates that “[t]he ‘step’ of producing a mixed alkanolamine in step (2) is unclear. It would appear that this step is actually composed of two separate and distinct reactions (alkylene oxide/liquid ammonia and alkylene oxide/aqueous ammonia, respectively) whose product[s] (mixtures) are combined.” See the Office Action, page 2, line 20 through page 3, line 4. According to the Specification, mixed alkanolamines can be a combination of the products of two distinct reactions, i.e., (a) the reaction of alkylene oxide with liquid ammonia in the presence of a zeolite catalyst and (b) the reaction of alkylene oxide with aqueous ammonia. See, e.g., page 6, lines 5-9, and page 9, line 30 through page 12, line 20. Thus, the Examiner's interpretation of step (2) recited in claim 1 is accurate.

(3) The Examiner points out that “[t]he reason for the use of the word ‘respectively’ [recited in claims 3 and 16] is unclear, particular so when neither the physical reality of the claim limitations nor the grammar used in their description appears to require such a term” and suggests that “to avoid any possible ambiguity, ... the term simply be deleted.” See the Office Action, page 3, lines 7-11. Applicants have deleted this word from both claims 3 and 16.

(4) The Examiner indicates that “[t]he exact meanings of the terms “analyze” and “analyzer” [recited in claim 7] are unclear. That is, what type of analysis and analyzer does the claim contemplate and to what purpose?” See the Office Action, page 3, lines 13-15. Applicants have replaced the phrase “wherein the distillate is analyzed continuously or intermittently using an analyzer” recited in claim 7 with “further comprising determining the weight percentage of the trialkanolamine in the distillate before the redistilling step.” It is clear that the purpose of the step recited in amended claim 7 is to determine the weight percentage of the trialkanolamine in the distillate. It is also clear that the step recited in amended claim 7 is not limited to any particular method to achieve that purpose. Instead, the step can be carried out by any suitable method known in the art (e.g., gas chromatography).

(5) The Examiner points out that “claim [14] recites the limitation ‘the monoalkanolamine.’ There is insufficient antecedent basis for this limitation in the claim.” See the Office Action, page 3, lines 18-19. Applicants have replaced the article “the” before “monoalkanolamine” recited in claim 14 with “a” and respectfully submit that this ground for rejection has been overcome.

(6) The Examiner indicates that [i]t is unclear how the removal of ammonia by nitrogen bubbling [recited in claim 15] can be considered as a fractional distillation. The pertinent clause in the independent claim (claim 11) explicitly limits the removal of ammonia, *inter alia*, to removal by fraction[al] distillation.” See the Office Action, page 4, lines 1-4. Applicants have amended claim 15 to recite “further comprising removing at least a portion of the unreacted ammonia by means of a pressure distillation and/or nitrogen gas bubbling prior to the removing step.” It is clear that the step recited in amended claim 15 is a step performed before the fractional distillation, but not part of a fractional distillation.

For the reasons set forth above, Applicants submit that claims 1-19 are no longer indefinite and request that this rejection be withdrawn.

Rejection under 35 U.S.C. § 102(b)

Claims 11-18 are rejected as being anticipated by Ruider et al., U.S. Patent 6,323,371 (“Ruider”). See the Office Action, page 3, lines 15-16.

Applicants discuss independent claim 11 first. Amended claim 11 covers a process for refining a trialkanolamine from a mixed alkanolamine obtained by a reaction of an alkylene oxide with ammonia. The process includes, among others, distilling the resultant trialkanolamine using a distillation column without a filler.

Ruider describes preparing an alkanolamine (e.g., triethanolamine) having improved color quality by treating the alkanolamine with an effective amount of phosphorus acid or hypophosphorus acid or compounds thereof. See, e.g., the Abstract and column 5, line 52 to column 6, line 9. It does not teach distilling a trialkanolamine using a distillation column without a filler, as required by amended claim 11. Thus, claim 11 is not anticipated by Ruider. Neither are claims 12-18, all of which depend from claim 11.

Rejection under 35 U.S.C. § 103(a)

Claims 1-10 and 19 are rejected as being obvious over Cocuzza, U.S. Patent 3,849,262 (“Cocuzza”). See the Office Action, page 4, lines 17-18.

Applicants discuss independent claim 1 first. Amended claim 1 covers a process for producing a trialkanolamine having an APHA value of not more than 40. The process includes, among others, (1) producing a mixed alkanolamine, (2) removing unreacted ammonia, water, a monoalkanolamine, and a dialkanolamine from the mixed alkanolamine to obtain a mixture deprived of low-boiling substances, (3) removing a high-boiling substance by subjecting the mixture deprived of the low-boiling substances to vacuum distillation to obtain a distillate; and (4) redistilling the distillate obtained by a vacuum distillation using a distillation column without a filler to obtain a trialkanolamine. In other words, the process of amended claim 1 requires that, after removing low-boiling substances (e.g., a dialkanolamine), a crude trialkanolamine thus obtained is first vacuum distilled to remove a high-point substance (i.e., step (3)) and then redistilled using a distillation column with a filler (i.e., step (4)).

Cocuzza describes a process of separating monoethanolamine, diethanolamine, and triethanolamine from crude ethanolamine mixtures containing ethylene glycol, which is obtained by reacting aqueous ammonia with ethylene oxide. See, e.g., the Abstract. Cocuzza also describes (1) removing monoethanolamine from distillation column 1, (2) removing ethylene glycol from distillation column 3, and (3) separating triethanolamine from diethanolamine from distillation column 4. However, Cocuzza does not teach or suggest that, after removing dialkanolamine, a crude trialkanolamine is distilled to remove a high-boiling substance, i.e., step (3) recited in amended claim 1. Further, it also does not teach or suggest, after removing the high-boiling substance, redistilling the crude trialkanolamine using a distillation column without a filler, i.e., step (4) recited in amended claim 1. Note that Cocuzza describes distillation columns 1 and 3 containing 10-20 and 15 plates (i.e., a filler), respectively. See, e.g., column 3, lines 6-7 and column 4, lines 34-35. In view of this teaching, one skilled in the art would not have been motivated to distill a crude trialkanolamine using a distillation column without a filler, as required by step (4) recited in claim 1. Thus, claim 1 is not obvious over Cocuzza.

Even if a *prima facie* case of obviousness has been made (which Applicants do not concede), it can be successfully rebutted by a showing of an unexpected advantage of the process

of claim 1. In particular, according to the Specification, distillation of a crude trialkanolamine using a column without a filler results in a trialkanolamine having far better color quality than that of the trialkanolamine obtained from a distillation using a column with a filler. For example, Comparative Example 1 describes distilling a crude triethanolamine (TEA) using a distillation column without a filler. See Table 1. The results show that the TEA thus obtained had a hue (i.e., APHA) value of 80 and absorbencies, determined by a phosphorus coloration test, of 1.2, 0.19, and 0.29 at wavelengths of 420, 510, and 530 nm, respectively. By contrast, Example 3 describes distilling a crude TEA using a distillation column with a filler. The results show that the TEA thus obtained had a hue value of 100 or higher and absorbencies of 1.8, 0.61, and 0.49 at wavelengths of 420, 510, and 530 nm, respectively. Given this unexpected advantage, claim 1 is clearly not obvious over Cocuzza.

Since claims 2-10 depend from claim 1, they are also not obvious over Cocuzza. As amended claim 19 now depends from claim 11, instead of claim 1, Applicants submit that its rejection on this ground is moot.

#### Double Patenting

Claim 19 is rejected as being a substantial duplicate of claim 10. The Examiner suggests that "claim 19 should properly depend from claim 11." See the Office Action, page 8, lines 13-19. Applicants have changed the dependency of claim 19 pursuant to the Examiner's suggestion. Applicants submit that claim 19 is no longer a duplicate of claim 10 and request withdrawal of this rejection.

#### CONCLUSION

Applicants submit that the grounds for rejection asserted by the Examiner have been overcome, and that claims 1-4 and 6-19, as pending, define subject matter that is definite, novel, and nonobvious. On this basis, it is submitted that all pending claims are now in condition for allowance, an action of which is requested.

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Enclosed is a check for the Petition for Extension of Time fee. Please apply any other charges to deposit account 06-1050, referencing Attorney's Docket No.: 08917-094001.

Respectfully submitted,

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